ABSTRACT OF THE DISCLOSURE

A semi-closed combined cycle power system 100 is provided which can also convert an open combined cycle gas turbine 10 into a non-polluting zero emissions power system. The prior art open combined cycle gas turbine 10 includes a compressor 20 which compresses air A' and combusts the air A' with a fuel, such as natural gas. The products of combustion and the remaining portions of the air form the exhaust E' which is expanded through the turbine 40. The turbine 40 drives the compressor 20 and outputs power. The exhaust E' exits the turbine 40 and then can optionally be routed through a heat recovery steam generator 50 to function as a combined cycle. According to this invention, the exhaust E' is not emitted into the atmosphere, but rather is routed to a divider 110. The divider 110 includes two outlets for the exhaust E' including a return duct 120 and a separation duct 130 which both receive a portion of the exhaust E'. The return duct 120 routes a portion of the exhaust E' back to the compressor 20. Before reaching the compressor 20, an oxygen duct 150 adds additional oxygen to the exhaust E' to form a gas mixture C which includes CO_2 and steam from the exhaust E' and oxygen from the oxygen duct 150. This gas mixture C has characteristics which mimic those of air, so that the compressor 20 need not be modified to effectively compress the gas mixture C. The gas mixture C is compressed within the compressor 20 and routed to the combustor 30 where the fuel combusts with the oxygen of the gas mixture C' and produces exhaust E' which is substantially entirely CO_2 and steam. This exhaust E' is routed through the turbine 40 and expanded to drive the compressor 20 and output power. The exhaust E' exits the turbine 40 and is routed back to the divider 110, preferably by way of a heat recovery steam generator 50 or other heat removal device, so that the semi-closed cycle operates as a combined cycle power system 100. The divider 110 directs a portion of the exhaust E' to a separation duct 130 which leads to a condenser 140. In the condenser 140 the exhaust E' is separated by condensation of the steam/water portion of the exhaust and removal of the remaining CO_2 as gas from

the condenser 140. The only exhaust from the semi-closed power system 100 is water and CO_2 from the condenser. The CO_2 exhaust is substantially pure and ready for appropriate further handling and disposal. Hence, no pollutants are emitted from the semi-closed power system 100. The return duct 120 can include a partial condenser 210 to condense a portion of the steam within the exhaust E'. This condensed steam is then routed back through the heat recovery steam generator 50, where it is converted to steam. This steam can be injected through a steam injection port 233 directly into the combustor 30 to enhance the power output and efficiency of a steam injection power system 200 variation of this invention.